



PV Inverter

SUNNY BOY 1300TL / 1600TL / 2100TL

Installation Manual

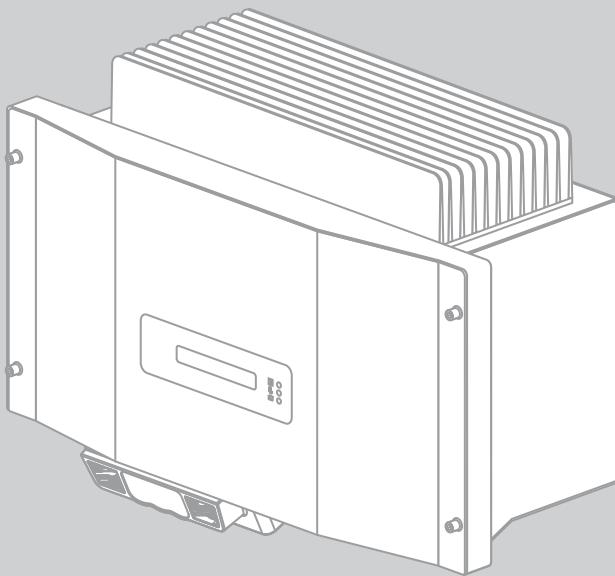


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1 Information on this Manual

Validity

This manual is valid for the following device types from firmware version 4.50:

- Sunny Boy 1300TL (SB 1300TL-10)
- Sunny Boy 1600TL (SB 1600TL-10)
- Sunny Boy 2100TL (SB 2100TL)

Target Group

This document is for skilled persons. Only persons with the appropriate skills are allowed to perform the tasks described in this manual (see Section 2.2 "Qualifications of Skilled Persons", page 8).

Additional Information

Additional information is available at www.SMA-Solar.com:

Document title	Document type
Application for SMA Grid Guard Code	Certificate
Capacitive Leakage Currents	Technical Information
Miniature Circuit-Breaker	Technical Information
Module Technology	Technical Information
Operating Parameters	Technical description
Insulation Resistance (R_{iso}) of Non-Galvanically Isolated PV Plants	Technical Information
Efficiency and Derating	Technical description
Temperature Derating	Technical Information
Criteria for Selecting a Residual-Current Device	Technical Information
Overvoltage protection	Technical Information

Icons

Icon	Explanation
 DANGER	Indicates a hazardous situation which, if not avoided, will result in death or serious injury
 WARNING	Indicates a hazardous situation which, if not avoided, could result in death or serious injury
 CAUTION	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury
 NOTICE	Indicates a situation which, if not avoided, could result in property damage
	Information that is important for a specific topic or goal, but is not safety-relevant
<input type="checkbox"/>	Indicates an essential requirement for achieving a specific goal
<input checked="" type="checkbox"/>	Desired result
	A problem that might occur

Nomenclature

Full Designation	Designation in this Document
Electronic Solar Switch	ESS
SMA Bluetooth® Wireless Technology	Bluetooth
Sunny Boy	Inverter, product

2 Safety

2.1 Appropriate Usage

The Sunny Boy is a transformerless PV inverter which converts the direct current of the PV array to grid-compliant alternating current and feeds it into the electricity grid.

The product is suitable for indoor and outdoor use.

The inverter must only be operated with PV arrays of protection class II, in accordance with IEC 61730, application class A. The PV modules used must be suitable for use with this inverter and must be approved by the module manufacturer.

It is only permissible to use PV modules with large capacities to earth providing that their coupling capacity does not exceed 1.4 μF .

All components must remain within their permitted operating ranges at all times.

Use this product only in accordance with the information provided in the enclosed documentation and with the locally applicable standards and guidelines. Any other use may result in personal injury or property damage.

The product should only be used in countries for which it is licensed or for which it is released by SMA Solar Technology AG and the network operator.

- Do not mount the product on flammable construction materials.
- Do not mount the product in areas where highly flammable materials are stored.
- Do not install the product in potentially explosive atmospheres.

For safety reasons, it is not permitted to modify the product or install components that are not explicitly recommended or distributed by SMA Solar Technology AG for this product.

The enclosed documentation is an integral part of this product.

- Read and observe the documentation.
- Keep the documentation in a convenient place for future reference.

2.2 Qualifications of Skilled Persons

The work described in this document must be performed by skilled persons only. Skilled persons must have the following qualifications:

- Knowledge of how an inverter works and is operated
- Training in how to deal with the dangers and risks associated with installing and using electrical devices and plants
- Training in the installation and commissioning of electrical devices and plants
- Knowledge of the applicable standards and guidelines
- Knowledge of and compliance with this document and all the safety precautions.

2.3 Safety Precautions

To prevent personal injury or property damage and to ensure long-term operation of the product, read this section carefully and comply with the safety precautions at all times.

DANGER

Danger to life due to high voltages

When exposed to sunlight, the PV array generates dangerous DC voltage which is present in the DC conductors and the live components of the inverter. Touching the DC conductors or the live components can lead to lethal electric shocks.

- Do not touch the DC conductors.
- Do not touch any live components of the inverter.
- Prior to performing any work on the inverter, disconnect it from all voltage sources as described in this document (see Section 8).

If you disconnect the DC connectors from the inverter under load, an electric arc may occur, causing electric shock and burns.

- If the inverter is not equipped with an Electronic Solar Switch and the regulations in the country of installation require an external DC switch-disconnector, you must install an external DC switch-disconnector.
- Always switch the AC miniature circuit-breaker off and then disconnect the inverter on the DC side before pulling out the DC connectors.
- Danger to life due to high voltages

Touching a non-earthed PV module or array frame can result in fatal electric shock.

- Connect and earth the PV modules, array frame and electrically conductive surfaces in continuous conduction mode. Observe the applicable local regulations.

WARNING

Risk of burns due to hot surfaces

Some parts of the enclosure can get hot during operation.

- When in operation, touch the inverter on the enclosure lid only.

NOTICE**Damage to the inverter due to moisture and dust intrusion**

If the inverter is fitted with an ESS and this is not plugged in or not properly plugged in during operation, moisture and dust can penetrate the inverter. If the ESS is not correctly plugged in, the ESS contacts may be subject to wear, or the ESS may detach from the socket. This can result in yield loss and damage to the ESS.

Always plug the ESS in as follows:

- Firmly plug the ESS in until it is flush with the enclosure.
- Ensure that the gap between the ESS and the enclosure is no more than 1 mm.

Damage due to electrostatic discharge

Touching electronic components can cause damage to or destroy the inverter through electrostatic discharge.

- Earth yourself before touching any components.

3 Scope of Delivery

Check the scope of delivery for completeness and any visible damage. Contact your specialist dealer if the delivery is incomplete or damaged.

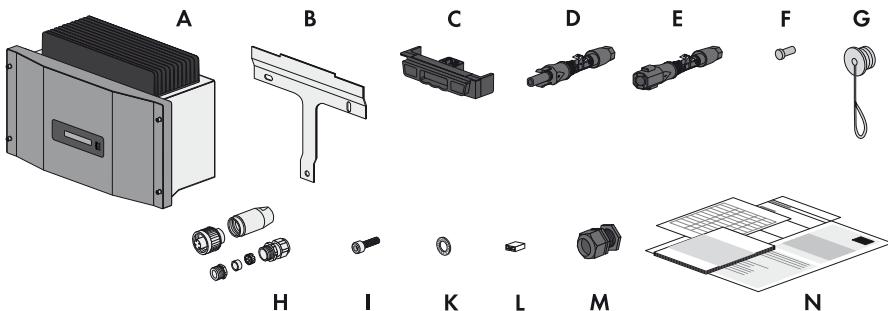


Figure 1: Parts included in the scope of delivery

Object	Quantity	Description
A	1	Sunny Boy
B	1	Wall mounting bracket
C	1	Electronic Solar Switch (ESS)*
D	1/2	Positive DC connector Sunny Boy 1300TL-10 / 1600TL-10: 1 each Sunny Boy 2100TL: 2 each
E	1/2	Negative DC connector Sunny Boy 1300TL-10 / 1600TL-10: 1 each Sunny Boy 2100TL: 2 each
F	2/4	Sealing plugs Sunny Boy 1300TL-10 / 1600TL-10: 2 each Sunny Boy 2100TL: 4 each
G	1	Protective cap for the AC socket on the inverter
H	1	AC coupling socket: bush insert, threaded sleeve, pressure screw PG13.5, sealing ring PG13.5, clamping cage PG13.5, cable gland M20x1.5
I	1	M6x12 cheese-head screw
K	1	Conical spring washer
L	1	Jumper
M	1	Cable gland PG16 with two-hole cable support sleeve
N	1	Installation manual, user manual, document set with declarations and certificates, supplementary sheet with the default settings of the inverter

* optional

4 Product Description

4.1 Sunny Boy

The Sunny Boy is a transformerless PV inverter, which converts the direct current of the PV array to grid-compliant alternating current and feeds it into the electricity grid.

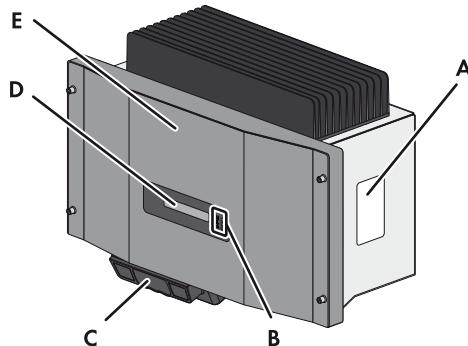


Figure 2: Components of the Sunny Boy

Item	Description
A	Type label
B	LEDs
C	ESS*
D	Display
E	Enclosure lid

* optional

Icons on the Inverter

Icon	Explanation
	Inverter This icon is located next to the green LED which indicates feed-in operation of the inverter.
	Earth fault or varistor defective This icon is located next to the red LED which indicates an earth fault or a defective varistor (see Section 10.5 "Red LED Permanently On", page 54).

Icon	Explanation
	<p>Refer to the documentation. This icon is located next to the yellow LED which indicates a fault or disturbance (see Section 10 "Troubleshooting", page 45).</p>
	<p>Protective conductor connection</p>
	<p>You can operate the display by tapping the enclosure lid as follows:</p> <ul style="list-style-type: none"> Single tap: switches the display backlight on or switches to the next display message. The backlight goes off automatically after 2 minutes. Double tap: the display successively shows the firmware version, the serial number or designation of the inverter, the configured country data set and the display language.
	<p>Operating principle of the ESS*</p> <ul style="list-style-type: none"> ➊ When the ESS is plugged in, the DC electric circuit is closed. ➋ To interrupt the DC electric circuit, you must perform the following steps in the order given: <ul style="list-style-type: none"> - ➊ Remove the ESS. - ➋ Release and disconnect all DC connectors.
	<p>QR Code® Links to additional information on the inverter can be found at www.SMA-Solar.com.</p>
	<p>Risk of burns from hot surfaces The product can get hot during operation. Avoid contact during operation. Allow the product to cool down sufficiently before carrying out any work. Wear personal protective equipment such as safety gloves.</p>
	<p>Danger to life due to high voltages in the inverter; wait 10 minutes.</p> <ul style="list-style-type: none"> High voltages capable of causing fatal electric shocks are present in the live components of the inverter. Disconnect the inverter from all voltage sources before performing any work on it (see Section 8).

* optional

4.2 Type label

The type label provides a unique identification of the inverter. The type label is located on the right-hand side of the enclosure. You will find the following information on the type label:

- Device type (Model)
- Serial number (Serial No.)
- Date of manufacture
- Device-specific characteristics

You will need the information on the type label to use the product safely and for customer support from the SMA Service Line. The type label must be permanently attached to the product.

Symbols on the Type Label

Icon	Explanation
	<p>Danger to life due to high voltages</p> <p>The product operates at high voltages. All work on the product must be carried out by skilled persons only.</p>
	<p>Risk of burns from hot surfaces</p> <p>The product can get hot during operation. Avoid contact during operation. Allow the product to cool down sufficiently before carrying out any work. Wear personal protective equipment such as safety gloves.</p>
	<p>Refer to the documentation.</p> <p>Observe all documentation supplied with the product.</p>
— — —	Direct current
	The product does not have a transformer.
	Alternating current
	<p>WEEE designation</p> <p>Do not dispose of the product together with the household waste but in accordance with the locally applicable disposal regulations for electronic waste.</p>
	<p>CE marking</p> <p>The product complies with the requirements of the applicable EU directives.</p>

Icon	Explanation
IP65	Degree of protection: IP65 The product is protected against dust intrusion and water jets from all angles.
	The product is suitable for outdoor installation.
	RAL quality mark for solar products The product complies with the requirements of the German Institute for Quality Assurance and Certification.
	C-Tick The product complies with the requirements of the applicable Australian EMC standards.

4.3 Electronic Solar Switch (ESS)

Depending on the order option, the inverter may be equipped with an ESS. Together with the DC connectors, the ESS forms a DC switch-disconnector. There are two types of ESS with different plug designs. The function of the ESS is identical in both cases.

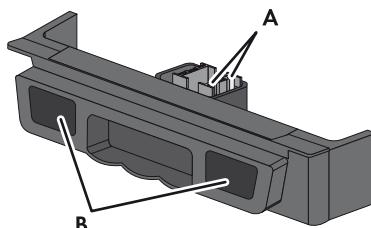


Figure 3: Example of the ESS design with visible metal mounting tabs

Item	Description
A	Depending on the type of ESS, the metal mounting tabs in the plug will either be visible or enclosed in a plastic casing.
B	Label with the operating principle of the ESS: <ul style="list-style-type: none"> ➊ When the Electronic Solar Switch is plugged in, the DC circuit is closed. ➋ To interrupt the DC circuit, you must perform the following steps in the order given: <ul style="list-style-type: none"> - ➊ Remove the ESS. - ➋ Release and disconnect all DC connectors.

When plugged in, the ESS forms a conductive link between the PV array and the inverter. Remove the ESS to interrupt the DC circuit and pull all DC connectors out to disconnect the PV array completely from the inverter.

4.4 Display and LEDs

The display and the LEDs of the inverter are located on the enclosure lid and indicate the operating state of the inverter.

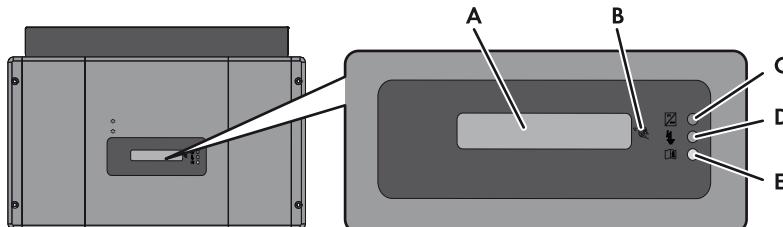


Figure 4: Display and LEDs

Item	Explanation
A	Two-line LC text display for displaying operating data and messages
B	You can operate the display by tapping the enclosure lid as follows: <ul style="list-style-type: none"> Single tap: switches the display backlight on or switches to the next display message. The backlight goes off automatically after 2 minutes. Double tap: the display successively shows the firmware version, the serial number or designation of the inverter, the configured country data set and the display language.
C	The green LED indicates the feed-in state of the inverter.
D	The red LED indicates an earth fault or a defective varistor.
E	The yellow LED indicates a fault or disturbance (see Section 10 "Troubleshooting", page 45).

The display shows the current operating data of the inverter (e.g. status, power output, input voltage) and errors or disturbances (see Section 10.2 "Display Messages", page 46).

The LEDs indicate the operating state of the inverter and clarify the display messages by means of various blink codes (see Section 10.1 "LED Signals", page 45).

4.5 Slot for Communication Interface

The inverter can be fitted with an SMA communication interface (e.g. RS485) or it may have been factory-fitted according to the order. This communication interface will enable the inverter to communicate with specific SMA communication products (for information on supported products, see www.SMA-Solar.com). You can only set the operating parameters of the inverter via SMA communication products.

Depending on the type of communication, the parameters and messages are displayed differently on the communication products.

Example: How the country data set parameter is displayed

For communication via RS485: parameter **Default**

For communication via *Bluetooth* or Speedwire/Webconnect: parameter **Set country standard**

This manual specifies the parameter names and messages for both types of communication.

4.6 Fault Indicator Relay

The inverter is equipped with a fault indicator relay which will signal faults depending on the type of output device connected. You can connect your own load to this relay (e.g., warning light, acoustic signal) (see Section 6.5 "Connecting the Fault Indicator Relay", page 34).

In case of critical disturbances, the fault indicator relay will close immediately and trigger the warning signal through the load. In case of non-critical disturbances, the fault indicator relay will only close after several flashing cycles of the yellow LED. When the inverter reconnects to the electricity grid, the fault indicator relay opens again.



Error message required by technical standards

In some countries, an error message is mandatory to comply with the requirements of a technical standard, e.g. IEC 62109-2.

To fulfil the requirements of the IEC 62109-2, you will either need to connect a display unit to the fault indicator relay to signal the fault or disturbance, or you will need to register the inverter in Sunny Portal and activate fault alert in Sunny Portal (for information on fault alert via Sunny Portal, see Sunny Portal user manual at www.SMA-Solar.com).

4.7 Operating Parameters

The performance of the inverter is controlled by various operating parameters. The operating parameters of the inverter can only be adjusted using an SMA communication product (for information on the operating parameters, please refer to the Technical Description "Operating Parameters" at www.SMA-Solar.com).

4.8 Grid Management

The inverter is equipped with grid management functions. Depending on the requirements of the network operator, you can activate and configure the functions (e.g. active power limitation) via operating parameters (for information on the functions and operating parameters, see Technical Description "Operating Parameters" at www.SMA-Solar.com).

4.9 Varistors

Varistors are voltage-dependent resistors to protect the inverter against overvoltage. The inverter is equipped with thermally monitored varistors.

Varistors are subject to wear with age or repeated strain as a result of overvoltage, which diminishes their protective function. The inverter detects if one of the varistors is defective and signals an error (see Section 10.5.2 "Checking the Function of the Varistors", page 55).

The varistors are specially manufactured for use in the inverter and are not commercially available. You must order new varistors directly from SMA Solar Technology AG.

4.10 SMA Grid Guard

SMA Grid Guard acts as an automatic disconnection device between a grid-parallel generator (e.g. a PV plant or small wind turbine system) and the electricity grid.

Furthermore, SMA Grid Guard is a grid monitoring concept, which detects errors by permanently monitoring grid impedance, mains voltage and mains frequency. For example, SMA Grid Guard detects when a stand-alone grid is formed and disconnects the inverter from the electricity grid immediately.

In some countries, the connection conditions stipulate installation of a device which protects grid-relevant operating parameters from unauthorised changes. SMA Grid Guard performs this function.

Some country data sets are automatically protected after the first ten feed-in hours. After the initial ten feed-in hours, the protected country data sets can only be changed via a communication product and by entering a personal access code, the SMA Grid Guard code (for information on how to change parameters, see communication product manual). You can obtain the SMA Grid Guard code from SMA Solar Technology AG (to apply for the SMA Grid Guard code, see certificate "Application for the SMA Grid Guard Code" at www.SMA-Solar.com).

5 Installation

5.1 Requirements for Installation

Requirements for the mounting location:

WARNING

Danger to life due to fire or explosions

Despite careful construction, electrical devices can cause fires.

- Do not mount the inverter on flammable construction materials.
- Do not mount the inverter in areas where highly flammable materials are stored.
- Do not mount the inverter in a potentially explosive atmosphere.

- Do not mount the inverter on a pillar.
- The mounting location must be inaccessible to children.
- A solid foundation must be available for mounting, e.g. concrete or masonry. When mounted on plasterboard or similar materials, the inverter will emit audible vibrations during operation, which could be perceived as annoying.
- The mounting location must be suitable for the weight and dimensions of the inverter (see Section 12 "Technical Data", page 60).
- Climatic conditions must be met (see Section 12 "Technical Data", page 60).
- The ambient temperature must be below 40 °C to ensure optimum operation of the inverter. If the power output is reduced, the inverter can also be operated at higher ambient temperatures without risk.
- The mounting location should be freely and safely accessible at all times without the necessity for any auxiliary equipment, such as scaffolding or lifting platforms. Non-fulfillment of these criteria may restrict the execution of service assignments.
- The mounting location must not be exposed to direct solar irradiation. Direct solar irradiation can cause the inverter to overheat. As a result, the inverter reduces its power output.

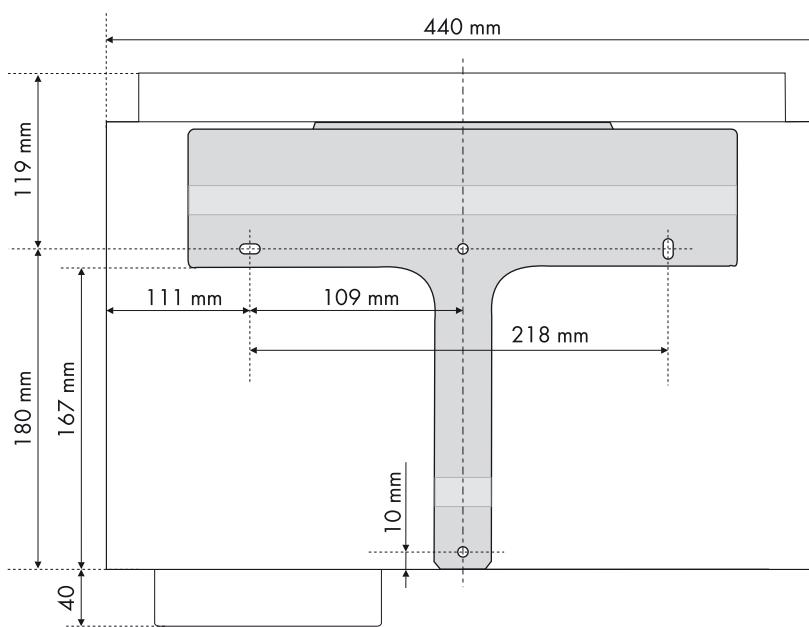
Dimensions for wall mounting:

Figure 5: Dimensions of wall mounting bracket

Recommended clearances:

Provided that the recommended clearances are observed, adequate heat dissipation will be ensured. This will prevent a reduction in inverter power as a result of high temperatures (details of temperature derating can be found in the Technical Information "Temperature Derating" at www.SMA-Solar.com).

- Observe the recommended clearances to walls as well as to other inverters or objects.
- If multiple inverters are mounted in areas with high ambient temperatures, increase the clearances between the inverters and ensure sufficient fresh-air supply.

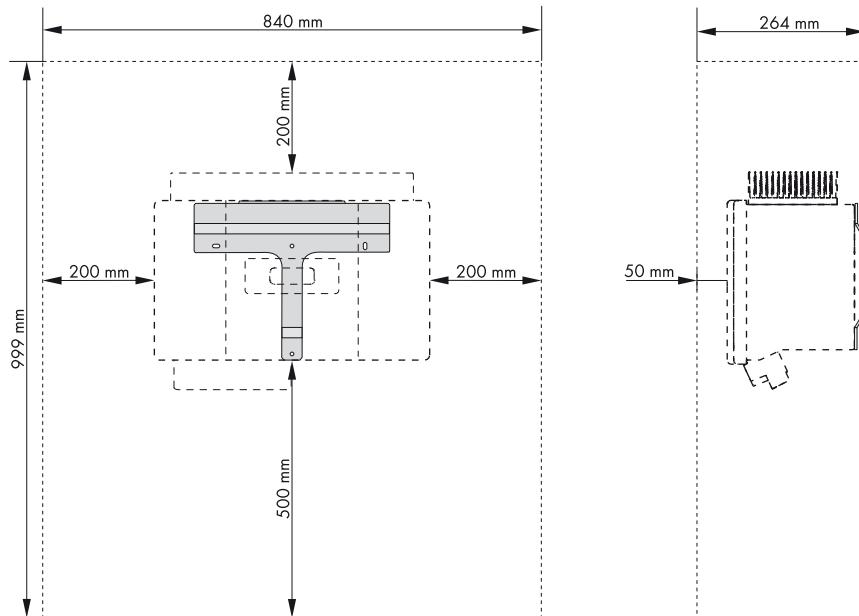


Figure 6: Recommended clearances

Permitted and prohibited mounting positions:

- The inverter must be mounted in one of the permitted positions. This will ensure that no moisture can penetrate the inverter.
- The inverter should be mounted at eye level. This will ensure that display messages and LED signals can be read without difficulty.

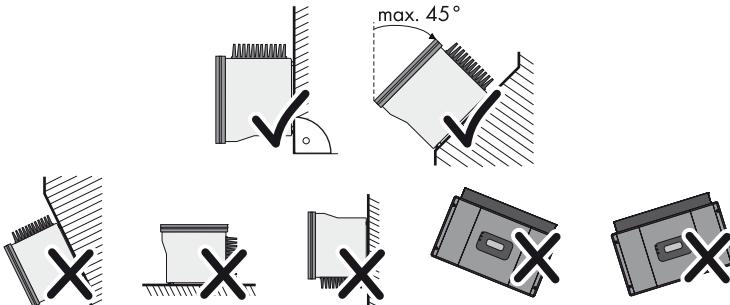


Figure 7: Permitted and prohibited mounting positions

5.2 Mounting the Inverter

Additionally required mounting material (not included in the scope of delivery):

- 2 screws suitable for the weight of the inverter and the mounting surface
- 2 washers suitable for the screws
- If necessary, 2 wall plugs suitable for the mounting surface and the screws

CAUTION

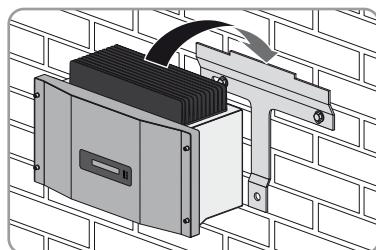
Risk of injury when lifting the inverter, or if it is dropped

The inverter is heavy (see Section 12 "Technical Data", page 60). There is risk of injury if the inverter is lifted incorrectly or dropped during transport or while being fixed to the wall mounting bracket.

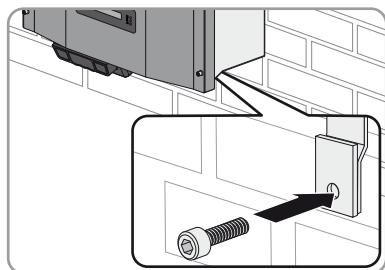
- Keep the inverter horizontal during transport.

Procedure:

1. Ensure that no cables are laid in the wall which could be damaged when drilling holes.
2. Align the wall mounting bracket horizontally on the wall and use it to mark the position of the drill holes.
3. Fasten the wall bracket on the wall with suitable mounting material.
4. Hook the inverter into the wall mounting bracket, ensuring that it cannot slide sideways out of the bracket.



5. If local requirements stipulate additional earthing or equipotential bonding, carry out additional earthing on the enclosure (see Section 6.3.3).
6. If no additional earthing or equipotential bonding is required, secure the inverter to the wall mounting bracket with the M6x12 screw to prevent it being lifted off.



7. Ensure that the inverter is securely attached.

6 Electrical Connection

6.1 Safety during Electrical Connection

Electric Shock

When exposed to sunlight, the PV array generates dangerous DC voltage which is present in the DC conductors and the live components of the inverter. Touching the DC conductors or the live components can lead to lethal electric shocks.

- Do not touch the DC conductors.
- Do not touch any live components of the inverter.
- Prior to performing any work on the inverter, disconnect it from all voltage sources as described in this document (see Section 9).

Electrostatic discharge

Touching electronic components can cause damage to or destroy the inverter through electrostatic discharge.

- Earth yourself before touching any components.

6.2 Overview of the Connection Area

6.2.1 View from Below

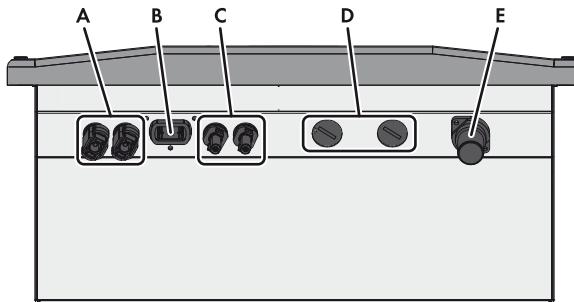


Figure 8: Connection areas and enclosure openings at the bottom of the SB 2100TL

Item	Description
A	Positive DC connectors for positive DC cables (in SB 1300TL-10 and SB 1600TL-10 there is only 1 positive connector)
B	Socket for the ESS*
C	Negative DC connectors for negative DC cables (in SB 1300TL-10 and SB 1600TL-10 there is only 1 negative connector)
D	Enclosure openings with filler plugs for data cables
E	Female connector for AC coupling socket

* optional

6.2.2 Interior View

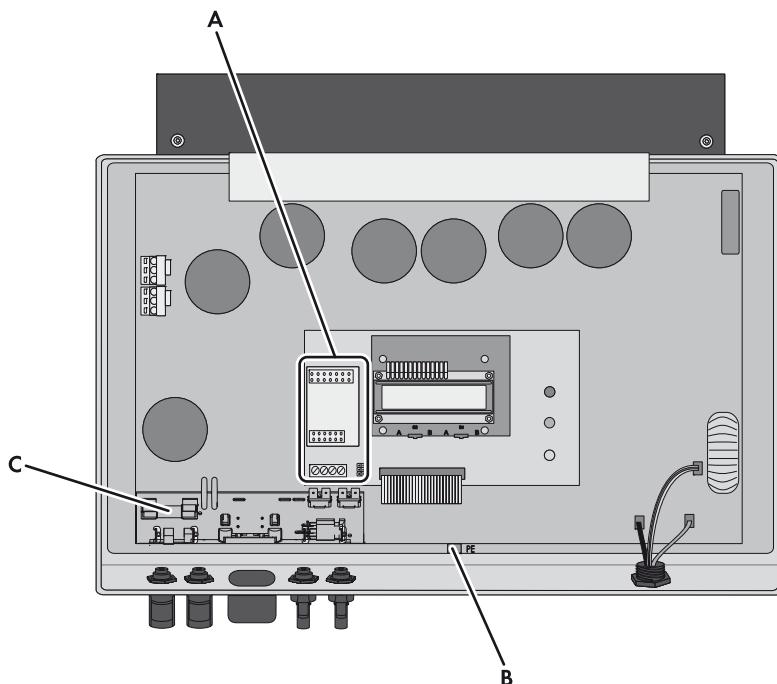


Figure 9: Connection areas in the interior of the inverter

Item	Description
A	Slot and connection area for SMA communication interface
B	Flat male tab for earthing the cable shield when communication takes place via RS485
C	Fuse for the Electronic Solar Switch (ESS)**

* optional

6.3 AC Connection

6.3.1 Requirements for the AC Connection

Cable requirements:

- External diameter: 7 mm to 14 mm
- Conductor cross-section: max. 2.5 mm²
- Stripping length: 5 mm
- The cable must be dimensioned in accordance with any local and national guidelines on cable dimensions which specify requirements for the minimum conductor cross-section. Factors influencing cable dimensioning are e.g.: nominal AC current, type of cable, type of routing, cable bundling, ambient temperature and maximum specified line losses (for calculation of line losses, see design software "Sunny Design" from software version 2.0 at www.SMA-Solar.com).

Switch-disconnector and cable protection:

NOTICE

Damage to the inverter through use of screw-type fuses as switch-disconnectors

Screw-type fuses (e.g., DIAZED or NEOZED fuses) do not have load disconnection properties and may damage the inverter if it is disconnected under load.

- Do not use screw-type fuses as switch-disconnectors.
- Use a switch-disconnector or miniature circuit-breaker as a load disconnection unit (for information and examples for designing, see Technical Information "Miniature Circuit-Breaker" at www.SMA-Solar.com).

- In plants with multiple inverters, each inverter must be protected with a separate miniature circuit-breaker. Make sure that the maximum permissible fuse protection is observed (see Section 12 "Technical Data", page 60). That prevents residual voltage being present in the cable after disconnection.
- Loads installed between the inverter and the miniature circuit-breaker must be fused separately.

Residual-current monitoring unit:

- If an external residual-current device is a mandatory requirement, install a device that trips at a residual current of 100 mA or higher (for information on choice of residual-current devices, see Technical Information "Criteria for Selecting a Residual-Current Device" at www.SMA-Solar.com).

Overvoltage Category

The inverter can be deployed in grids of installation category III or lower, as defined under IEC 60664-1. This means that the inverter can be permanently connected at the grid-connection point in a building. In installations involving long cable routes outdoors, additional overvoltage-reducing measures must be taken so that the overvoltage category is reduced from IV to III (see Technical Information "Overvoltage Protection" at www.SMA-Solar.com).

6.3.2 Connecting the Inverter to the Electricity Grid

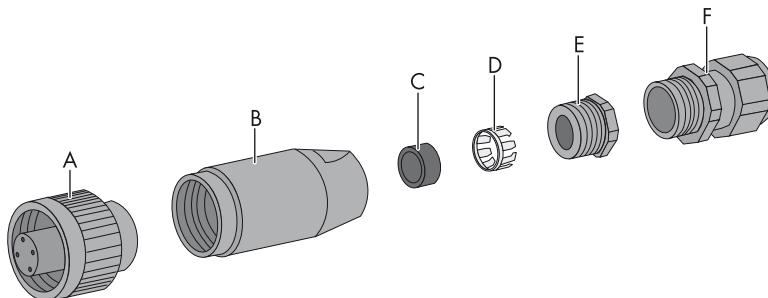


Figure 10: Overview of the AC coupling socket

Item	Description
A	Bush insert
B	Threaded sleeve
C	Sealing ring PG13.5
D	Clamping cage PG13.5
E	Pressure screw PG13.5 for cable diameter between 7 mm and 10 mm
F	Cable gland M20x1.5 for cable diameter between 10 mm and 14 mm

Requirements:

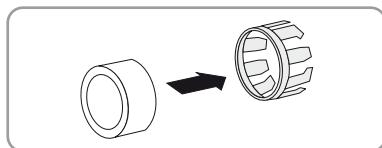
- The display language must be set to the required language (see Section 7.3 "Changing the Display Language", page 38).
- The connection requirements of the network operator must be met.
- The mains voltage must be within the permissible range. The exact operating range of the inverter is specified in the operating parameters (see Technical Description "Operating Parameters" at www.SMA-Solar.com).

Procedure:

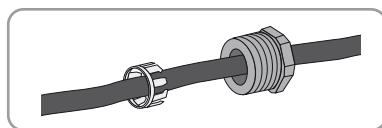
1. Select suitable cable gland for the AC cable
2. Disconnect the miniature circuit-breaker and secure against reconnection.
3. Strip the AC cable by 30 mm.
4. Shorten L and N by 5 mm each.
5. Strip the insulation of L, N, and PE by 4 mm each.

6. If the cable diameter is between 7 mm and 10 mm, use sealing ring, clamping cage and pressure screw as follows:

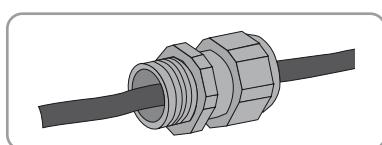
- Push the sealing ring into the clamping cage.



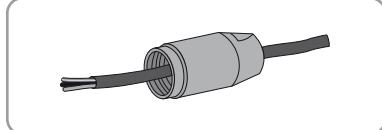
- Thread the PG13.5 pressure screw and the clamping cage with sealing ring onto the AC cable.



7. If the external cable diameter is between 10 mm and 14 mm, thread cable gland M20x1.5 onto the AC cable.

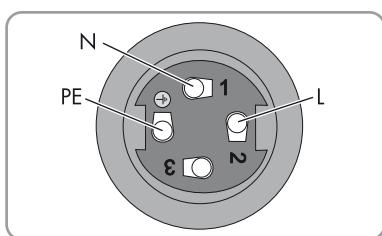


8. Thread the threaded sleeve onto the AC cable.

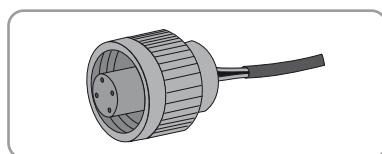


9. Connect PE, N and L to the bush insert as follows:

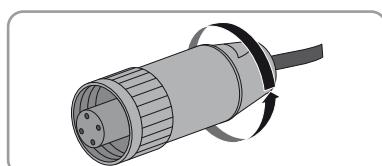
- Insert PE into the screw terminal with the earth symbol on the bush insert, and tighten the screw.
- Insert N into screw terminal 1 on the bush insert and tighten the screw.
- Insert L into screw terminal 2 on the bush insert and tighten the screw.



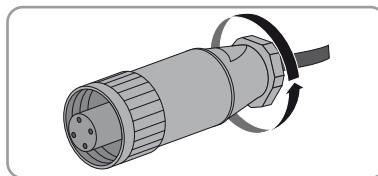
10. Ensure that the wires are firmly in place.



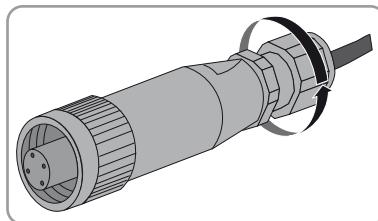
11. Screw the threaded sleeve tightly onto the bush insert.



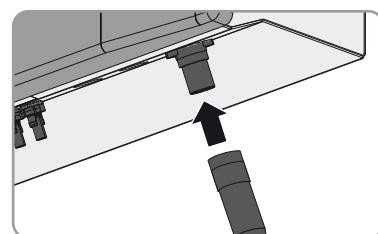
- When using pressure screw, clamping cage and sealing ring, screw the pressure screw firmly onto the threaded sleeve. In the process, the clamping cage will be pressed into the threaded sleeve and no longer be visible.



- When using the cable gland, screw the cable gland firmly onto the threaded sleeve.
 AC coupling socket is now assembled.



- Insert the AC coupling socket into the AC female connector on the inverter. If necessary, remove the protective cap beforehand.
- If the AC coupling socket is not to be connected to the inverter immediately, close the AC connector on the inverter with the protective cap provided.



6.3.3 Connecting Additional Earthing

You can carry out additional earthing of the inverter enclosure if local requirements stipulate additional earthing or equipotential bonding. This will prevent touch current if the original protective conductor fails.

Additional required material (not included in scope of delivery):

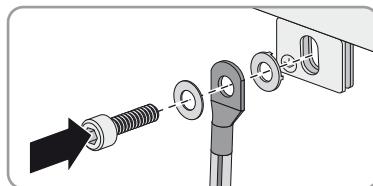
- Ring terminal lug M6
- 1 earthing cable

Cable requirement:

- Earthing cable cross-section: max. 16 mm²

Procedure:

1. Strip the earthing cable insulation.
2. Thread ring terminal lug onto earthing cable.
3. Align washer, earthing cable with ring terminal lug and conical spring washer on the cheese-head screw M6x12. The teeth of the conical spring washer must be facing the metal shackle on the inverter.
4. Insert the cheese-head screw through the metal shackle on the inverter and screw onto the wall mounting bracket (torque: 6 Nm).



6.4 DC Connection

6.4.1 Requirements for DC Connection

Requirements for the PV modules:

- All PV modules must be of the same type.
- The same number of series-connected PV modules must be connected to all strings.
- All PV modules must have the same alignment.
- All PV modules must have the same tilt angle.
- The maximum input current per string must be complied with and must not exceed the through-fault current of the DC connectors (see Section 12 "Technical Data", page 60).
- The thresholds for the input voltage and the input current of the inverter must be observed (see Section 12 "Technical Data", page 60).
- On the statistically proven coldest day of the year, the open-circuit voltage of the PV array should never exceed the maximum input voltage of the inverter.
- The positive connection cables of the PV modules must be fitted with the positive DC connectors (for information on assembling DC connectors, see the DC connector installation manual).

- The negative connection cables of the PV modules must be fitted with the negative DC connectors. (for information on assembling DC connectors, see the DC connector installation manual).
- If the inverter is not equipped with an Electronic Solar Switch and the regulations in the country of installation require an external DC switch-disconnector, you will need to install an external DC switch-disconnector.

i Use of Y adaptors for parallel connection of strings

The Y adaptors must not be used to interrupt the DC electric circuit.

- Do not use the Y adaptors in close proximity of the inverter. The adaptors must not be visible or freely accessible.
- In order to interrupt the DC electric circuit, disconnect the inverter from all voltage sources (see Section 8).

6.4.2 Connecting the PV Array

NOTICE

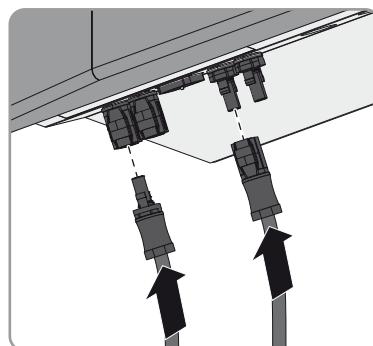
Destruction of the inverter due to overvoltage

If the open-circuit voltage of the PV modules exceeds the maximum input voltage of the inverter, the inverter can be destroyed by the overvoltage.

- If the open-circuit voltage of the PV modules is in excess of the maximum input voltage of the inverter, do not connect any strings to the inverter and check the design of the PV plant.

1. Disconnect the miniature circuit-breaker and secure against reconnection.
2. If an ESS is in use and plugged in, carefully pull it out.
3. If an external DC switch-disconnector is in use, disconnect it.
4. Check the PV strings for earth faults (see Section 10.5.1 "Checking the PV Array for Earth Faults", page 54).
5. Connect the assembled DC connectors to the inverter.

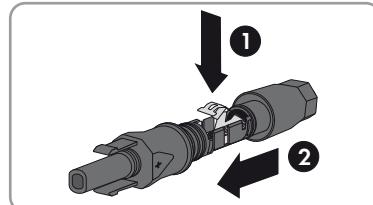
There is an audible click when the DC connectors are plugged in.



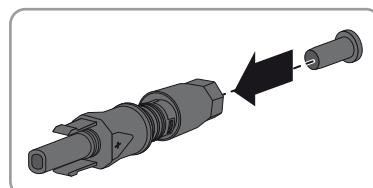
6. NOTICE**Damage to the inverter due to moisture penetration**

The inverter is only properly sealed when all the unused DC inputs are closed with DC connectors and sealing plugs.

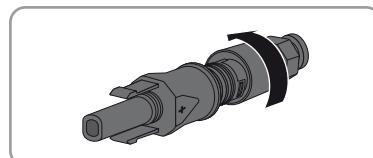
- Do not insert the sealing plugs directly into the DC inputs on the inverter.
- For unused DC connectors, push down the clamping bracket and push the swivel nut up to the thread.



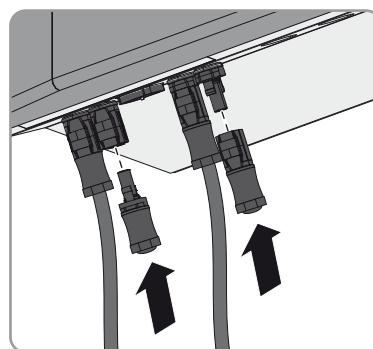
- Insert the sealing plug into the DC connector.



- Fasten the DC connector (torque: 2 Nm).



- Insert the DC connectors with sealing plugs into the corresponding DC inputs on the inverter.
- There is an audible click when the DC connectors are plugged in.



7. Ensure that all DC connectors are securely in place.
8. If an ESS is in use, check it for signs of wear (see Section 10).

9. NOTICE**Risk of fire due to tightening of the ESS screw**

Perfect contact between the ESS and the inverter can only be guaranteed if the ESS plug remains flexible.

- Do not tighten the screw in the plug of the ESS.

10. NOTICE**Damage to the inverter due to moisture and dust penetration**

If the ESS is not plugged in or incorrectly plugged in during operation, moisture and dust can penetrate the inverter. If the ESS is not correctly plugged in, the ESS contacts may be subject to wear, or the ESS may detach from the socket. This can result in yield loss and damage to the ESS.

Always plug the ESS in as follows:

- Firmly plug the ESS in until it is flush with the enclosure.
- Ensure that the gap between the ESS and the enclosure is no more than 1 mm.

6.5 Connecting the Fault Indicator Relay

You can use the fault indicator relay to have inverter errors displayed or reported. Alternatively, you can choose to have fault-free operation displayed or reported. It is possible to connect several inverters to one fault or operation indicator. To enable this function, the fault indicator relays of all the inverters must be connected.

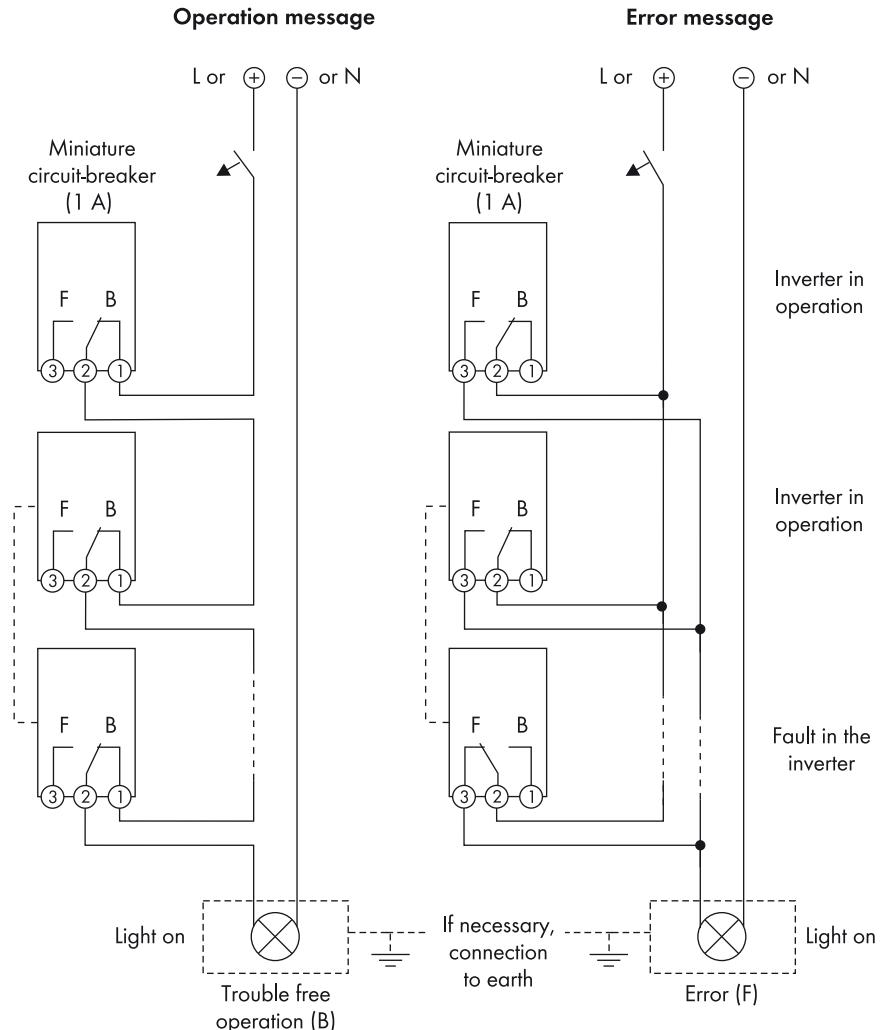


Figure 11: Wiring diagram with several inverters for connection of operation indicator and fault indicator (example)

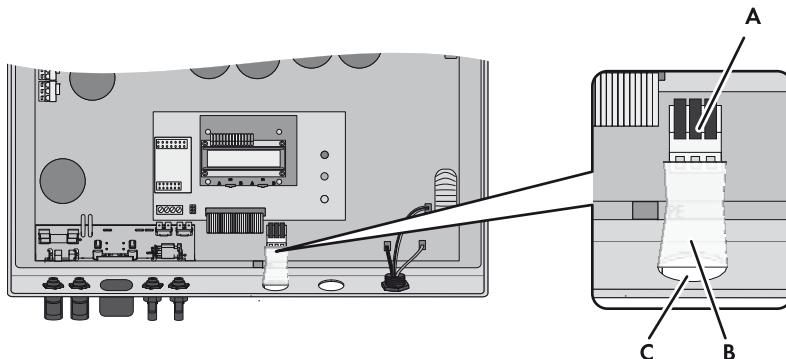


Figure 12: Fault indicator relay and cable route

Item	Description
A	Terminals of the fault indicator relay
B	Cable route
C	Enclosure opening with filler plug

Requirements

- The technical requirements of the fault indicator relay must be complied with (see Section 12 "Technical Data", page 60).

Cable Requirements

- The cable must be double-insulated.
- External diameter: 5 mm to 12 mm
- Conductor cross-section: 0.08 mm² to 2.5 mm²
- The cable type and routing method must be appropriate to the application and location.

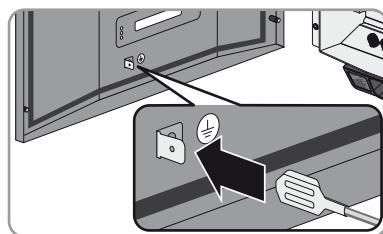
NOTICE

Destruction of the fault indicator relay as a result of contact overload

- Adhere to maximum switching voltage and maximum switching current (see Section "Fault Indicator Relay", page 63).
- When connecting the fault indicator relay to the electricity grid, protect it with an individual miniature circuit-breaker.

Procedure:

1. Ensure that the inverter is disconnected from the power supply (see Section 8).
2. Remove all screws from the enclosure lid and pull the enclosure lid evenly forward and off.
3. Remove the protective conductor (PE) connection from the bottom of the enclosure lid.
4. Prepare the cable as follows:
 - Strip the the cable jacket by a maximum of 15 mm.
 - Strip the conductor insulation by max. 8 mm.
5. Prepare the cable gland PG16 for connection to the fault indicator relay as follows:
 - Remove the swivel nut from the cable gland and remove the filler plug.
 - Remove the one-hole cable support sleeve from the cable gland and insert the cable into the cable support sleeve.
 - Press the cable support sleeve with the cable into the cable gland and lead the cable into the inverter.
 - Screw the swivel nut onto the cable gland.
6. Connect the cable to the fault indicator relay according to the circuit diagram.
7. Tighten the swivel nut of the cable gland.
8. Execute the protective conductor (PE) connection from the inverter to the bottom of the enclosure lid.



9. Fasten the enclosure lid to the inverter by evenly tightening the 4 lid screws (torque: 2 Nm).
10. Commission the inverter (see Section 7).

7 Initial Start-Up

7.1 Procedure

Before you can commission the inverter, you must check various settings and make any necessary changes. This section describes the procedure for initial start-up and provides an overview of the steps that must always be performed in the given sequence.

Procedure	
1.	Check the country data set configuration of the inverter. see supplementary sheet with default settings Type label or display
2.	If the country data set is not correctly configured for your country or purpose, set it to the required country data set (see Section 7.2 "Changing the Country Data Set", page 37)
3.	Check which configuration of the display language is set and adjust as necessary. (see Section 7.3 "Changing the Display Language", page 38)
4.	Carry out initial commissioning of the inverter and start self-test, if required. (see Section 7.4 "Commissioning the Inverter", page 39) and if applicable (see Section 7.5 "For Italy Only: Starting the Self-test", page 40)

7.2 Changing the Country Data Set

The inverter is set by default to a specific country data set. You can find the country data set configured on the inverter in the enclosed supplementary sheet with the default settings. If the configured country data set does not apply to your country, you will need to change the country data set via a communication product.



Country data set must be correctly configured

If you configure a country data set that is not valid for your country or particular application, this may cause a plant a disturbance and lead to problems with the network operator.

When selecting the country data set, always observe the locally applicable standards and directives, as well as the specific plant properties (e.g. plant size, grid-connection point, etc.).

- If you are not sure which country data set is applicable for your country or application, contact your network operator to clarify the appropriate country data set.

Requirements:

- The inverter must be equipped with a communication interface.
- A communication product that is appropriate for the type of communication used must be available.
- The responsible network operator must approve changes of grid-relevant parameters.
- An SMA Grid Guard code for changing the grid-relevant parameters must be available (to obtain this code, see certificate "Application for SMA Grid Guard-Code" at www.SMA-Solar.com).

Procedure:

1. Access the user interface of the communication product.
2. Enter the SMA Grid Guard code in the communication product (e.g. software).
3. Select the parameter **Default** or **Set country standard** and adjust to the required country data set.

7.3 Changing the Display Language

You can change the display language of the inverter. Various languages are available depending on the country data set selected.

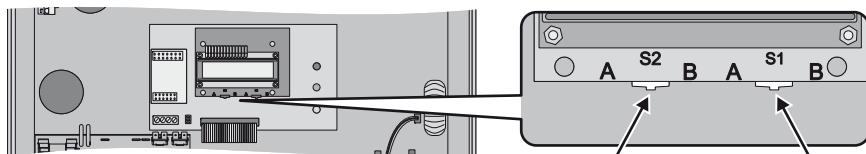


Figure 13: Two switches at the bottom of the display assembly

Procedure:

1. Ensure that the inverter is disconnected from the power supply (see Section 8).
2. Set the desired language using the two rotary switches:

Language	Rotary switch S2	Rotary switch S1
German	B	B
English / Italian*	B	A
French	A	B
Spanish / English**	A	A

* When country data set CEI 0-21 is selected, the language is Italian.

** When country data set CEI 0-21 is selected, the language is English.

3. Commission the inverter (see Section 7.4).

7.4 Commissioning the Inverter

Requirements:

- The inverter is correctly mounted.
- The miniature circuit-breaker is correctly rated and installed.
- All cables are correctly connected.
- Unused DC inputs are sealed with appropriate DC connectors and sealing plugs.
- The country data set is configured according to the country or application.
- If an ESS is in use, it is securely plugged in.
- The inverter is closed.

Procedure:

1. Switch the miniature circuit-breaker on.
2. If an external DC switch-disconnector is installed, switch it on.
 - The start-up phase begins.
 - The green LED is lit and the display consecutively shows the device type or designation of the inverter, the firmware version, and the configured country data set.
 - Green LED flashing
 - The DC input voltage is still too low, or the inverter is checking the electricity grid.
 - Once the DC input voltage is sufficiently high and the grid connection conditions are met, the inverter starts operation.
 - Red LED on
 - The inverter has detected an earth fault or one of the varistors is defective.
 - Eliminate the error (see Section 10.5 "Red LED Permanently On", page 54).
 - Yellow LED flashing
 - There is probably a fault or disturbance present.
 - Eliminate the fault or disturbance (see Section 10 "Troubleshooting", page 45).
3. If the inverter is being commissioned in Italy, start the self-test (see Section 7.5 "For Italy Only: Starting the Self-test", page 40)

7.5 For Italy Only: Starting the Self-test

The self-test only applies to inverters which are commissioned in Italy.

The Italian standard requires that all inverters feeding into the electricity grid perform a self-test in accordance with CEI 0-21. During the self-test, the inverter will consecutively check the reaction times for overvoltage, undervoltage, maximum frequency and minimum frequency.

During the self-test, the upper and lower trip-limit values for each protective function are changed on a linear basis for frequency monitoring and voltage monitoring. As soon as the measured value exceeds the permitted trip-limit value, the inverter disconnects from the electricity grid. Thus, the inverter determines the reaction time up to disconnection and performs the self-test.

After the self-test has been completed, the inverter automatically switches back to feed-in operation, resets the original calibration values and connects to the electricity grid. The test takes approx. 3 minutes.

Requirements:

- Configured country data set: **CEI0-21 Int / CEI 0-21 Intern** or amended country data set **trimmed / Special setting** based on **CEI0-21 Int / CEI 0-21 Intern**.
- A report for entering the test results in compliance with CEI 0-21 must be on hand.
- The inverter must be in operation and in the start-up phase.

Procedure:

1. As soon as the configured country data set appears in the display, tap the display once within ten seconds.
 - A message informing you that the self-test has started is shown in the display:
Avvio Autotest.
 - No message **Avvio Autotest** shown in the display
You have exceeded the ten-second time limit so the self-test cannot start.
 - Restart the self-test
- Tap the display within 20 seconds and enter the test results in the test report as they appear.
 - The self-test starts.
 - The inverter displays the results of the individual tests for overvoltage, undervoltage, maximum frequency and minimum frequency. The results are displayed three times in succession for ten seconds each.

Example: Display messages for overvoltage test

- Name of the test: **Autotest (59.S1) 240.00V**
- Disconnection value: **Valore di soglia con 230,00 V**
- Normative value: **Va. taratura 253.00V**
- Disconnection time: **Tempo intervento 0.02s**
- Current mains voltage: **Tensione di rete Val.eff.: 229.80V**

7.5.1 Abortion of the Self-Test

If an unexpected disconnection requirement occurs during the self-test, the self-test is aborted. The same applies if the DC voltage is so low that feed-in cannot be continued.

A message informing you that the self-test has been aborted is shown in the display for ten seconds: **Autotest interrotto**.

- Restart the self-test (see Section 7.4.3, page 47).

7.5.2 Restarting the Self-Test

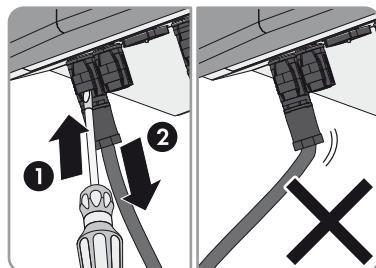
1. Disconnect the miniature circuit-breaker and secure against reconnection.
2. If an external DC switch-disconnector is in use, switch it off for 5 minutes and then switch it on again.
3. If an ESS is in use, pull it out of the inverter for 5 minutes and then plug it in again firmly.
4. Switch the miniature circuit-breaker on.
5. If an external DC switch-disconnector is in use, switch it on.

The inverter is now back in the start-up phase and you can start the self-test (see Section 7.5 "For Italy Only: Starting the Self-test", page 40).

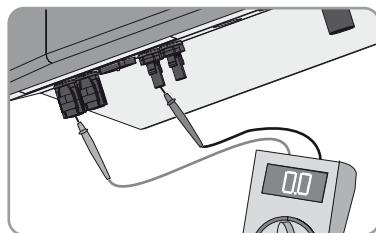
8 Disconnecting the Inverter from Voltage Sources

Before performing any work on the inverter, disconnect it from all voltage sources as described in this section. Always adhere strictly to the given sequence.

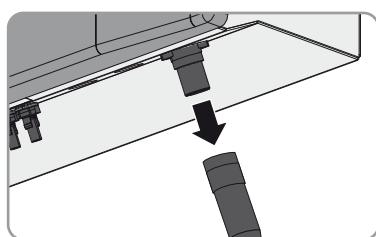
1. Disconnect the miniature circuit-breaker and secure against reconnection.
2. If an ESS is in use, carefully pull it out.
3. If an external DC switch-disconnector is in use, disconnect it.
4. Use a current clamp to ensure that no current is present in the DC cables.
5. Release and disconnect all DC connectors. To do so, insert a flat-blade screwdriver or an angled screwdriver (blade width: 3.5 mm) into one of the side slots and pull the DC connectors straight out. Do not pull on the cable.



6. Check that no voltage is present at the DC inputs on the inverter.



7. Pull the AC coupling socket out of the AC female connector on the inverter.



8. Wait until the all LEDs and the display have gone out.

DANGER

Danger to life due to high voltages

The capacitors in the inverter take 10 minutes to discharge.

- Wait 10 minutes before opening the inverter.

9 Recommissioning the Inverter

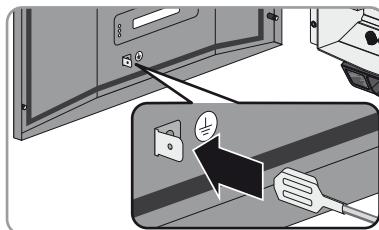
If you have disconnected the inverter from voltage sources (e.g. for configuration purposes) and want to restart it, proceed as follows.

Requirements:

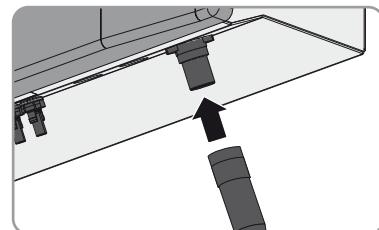
- The miniature circuit-breaker is correctly rated.
- The inverter is correctly mounted.

Procedure:

1. Make the protective conductor (PE) connection from the inverter to the bottom of the enclosure lid.



2. Fasten the enclosure lid to the inverter by evenly tightening the 4 lid screws (torque: 2 Nm).
3. Attach the AC connector.



4. Check the DC connectors for correct polarity and connect them to the inverter (see Section 6.4.2 "Connecting the PV Array", page 31).
5. Seal all unused DC inputs with DC connectors and sealing plugs.
6. If you are using an ESS, check it for wear (see Section 10).
7. **NOTICE**

Risk of fire due to tightening of the ESS screw

Perfect contact between the ESS and the inverter can only be guaranteed if the ESS plug remains flexible.

- Do not tighten the screw in the plug of the ESS.

8. **NOTICE**

Damage to the inverter due to moisture and dust penetration

If the ESS is not plugged in or incorrectly plugged in during operation, moisture and dust can penetrate the inverter. If the ESS is not correctly plugged in, the ESS contacts may be subject to wear, or the ESS may detach from the socket. This can result in yield loss and damage to the ESS.

Always plug the ESS in as follows:

- Firmly plug the ESS in until it is flush with the enclosure.
- Ensure that the gap between the ESS and the enclosure is no more than 1 mm.

9. Switch the miniature circuit-breaker on.

10. If an external DC switch-disconnector is installed, switch it on.

The start-up phase begins.

The green LED is on and the display consecutively shows the device type, the firmware version, the configured country data set.

Green LED flashing

Possible cause of error: the DC input voltage is still too low or the inverter is checking the electricity grid.

- Once the DC input voltage is sufficiently high and the grid connection conditions are met, the inverter starts operation.

Red LED on

The inverter has detected an earth fault or one of the varistors is defective.

- Eliminate the error (see Section 10.5 "Red LED Permanently On", page 54).

Yellow LED flashing

- Rectify the fault (see Section 10 "Troubleshooting", page 45).

10 Troubleshooting

10.1 LED Signals

Description	Status	Explanation
Green LED	glowing	Operation The specific status message is shown in the display (see Section 10.2.2 "Status Messages", page 46).
	flashing	Conditions for grid connection are not yet fulfilled.
Red LED	glowing	Earth fault or varistor defective The specific fault or disturbance message is shown in the display (see Section 10.2.3 "Errors, Disturbances, Warnings", page 47).
Yellow LED	glowing	Permanent operation inhibition The specific fault or disturbance message is shown in the display (see Section 10.2.3 "Errors, Disturbances, Warnings", page 47).
	flashing	Fault or disturbance The specific fault or disturbance message is shown in the display (see Section 10.2.3 "Errors, Disturbances, Warnings", page 47).



All LEDs are flashing

If the DC voltage is very low in the start-up phase, all three LEDs go out and the start-up phase recommences. If irradiation is very low, all three LEDs flash. This flashing indicates a normal operating state. It does not mean that a fault has occurred.



All LEDs have gone out

If all three LEDs have gone out, the inverter is switched off because the ESS is not plugged in, the external DC switch-disconnector is not switched on, or there is no irradiation.

10.2 Display Messages

10.2.1 Measurement Channels

Measurement channels are measured values which are shown on the display. The measurement channels can also be read out using a communication product.

Measurement channel	Explanation
E-today	Total amount of energy fed in on the current day
Status	Indicates the current operating state (see Section 10.2.2 "Status Messages", page 46).
Pac	AC power supplied
Vpv	PV input voltage
E-total	Total amount of energy fed in
h-total	Total number of operating hours in feed-in operation
Warning / fault / disturbance	Display of a current disturbance or fault with corresponding error message (see Section 10.2.3 "Errors, Disturbances, Warnings", page 47) When certain disturbances occur, the shutdown value and the current value are also displayed.

10.2.2 Status Messages

Status messages are shown in the second line of the display and always start with the word "Mode". Status messages indicate operating states which do not constitute faults or disturbances. The inverter continues feeding into the electricity grid.

Message	Explanation
Derating	This message can have several causes: <ul style="list-style-type: none"> • Overtemperature in the inverter. The inverter reduces its power to prevent overheating. • External active power limitation via the Power Reducer Box and Sunny WebBox. The inverter reduces its power output automatically based on network operator specifications. The Power Reducer Box transfers the signal from the network operator to the inverter via the Sunny WebBox.
Error	The inverter has detected a fault. The specific error message is also displayed (see Section 10.2.3 "Errors, Disturbances, Warnings", page 47).
MPP	The inverter is operating in MPP mode. MPP is the standard display message when operating under normal irradiation conditions.

MPP Peak	The inverter is operating in MPP mode above its nominal power.
MPP-Search	The inverter is calculating the MPP.
Grid monitoring	Grid monitoring. If irradiation is low or an error has occurred, this message appears before the inverter is connected to the electricity grid.
Offset	Offset alignment of the measurement electronics
Riso	Measuring the insulation resistance of the PV plant
Disturbance	The inverter has detected a disturbance. The specific disturbance message is also displayed (see Section 10.2.3 "Errors, Disturbances, Warnings", page 47).
Stop	Operation interrupted
V-Const	Constant voltage mode.
Waiting	The conditions for grid connection are not (yet) fulfilled.

10.2.3 Errors, Disturbances, Warnings

Errors, disturbances and warnings are shown in the display and start in the first line with the word "Error", "Fault" or "Warning". In the second line of the display, the cause of the error, fault or warning is shown.

Message	Description and Corrective Measures
!PV-Overvoltage! !DISCONNECT DC!	<p>Overvoltage at the DC input. The inverter may be destroyed. This message is additionally highlighted by rapid flashing of the backlight.</p> <p>Corrective measures:</p> <ol style="list-style-type: none"> 1. Disconnect the miniature circuit-breaker. 2. If there is an external DC switch-disconnector, turn it off. 3. If an ESS is in use, disconnect it. 4. Release and disconnect all DC connectors using a screwdriver (blade width 3.5 mm). <ul style="list-style-type: none"> – Insert a screwdriver into one of the side slots. – Pull the DC connectors out. 5. Check whether the DC voltage is below the maximum input voltage of the inverter. If the DC voltage is below the maximum input voltage of the inverter, reconnect the DC connectors to the inverter. If the DC voltage is above the maximum input voltage of the inverter, check the PV plant design or contact the installer of the PV array. 6. If this message recurs frequently, disconnect the inverter from voltage sources (see Section 8) and contact the SMA Service Line.

Message	Description and Corrective Measures
ACVtgRPro	<p>The ten-minute average of the mains voltage is no longer within the permissible range. The mains voltage or grid impedance at the connection point is too high. The inverter disconnects from the electricity grid to comply with the power quality.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> Check that the mains voltage at the connection point of the inverter is permanently within the permissible range. If the mains voltage is 253 V or higher, contact the network operator. Ask the network operator whether the voltage can be adapted at the feed-in point or whether it would be acceptable to change the threshold of the ACVtgRPro / Voltage increase protection parameter. If the mains voltage is permanently within the permissible range and this message is still displayed, contact the SMA Service Line.
Bfr-Srr	<p>Internal measurement comparison fault or hardware defect.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> Contact the SMA Service Line if this disturbance occurs frequently.
Check PE	<p>PE is not connected.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> Ensure that the AC cable is connected correctly (see Section 6.3.2 "Connecting the Inverter to the Electricity Grid", page 27). If the AC cable is connected correctly and this message is still displayed, contact the SMA Service Line.
Derating	<p>The inverter reduces its power output due to overheating.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> Ensure sufficient ventilation.
Fault Curr Meas	<p>Deviation in the differential current measurement. If this message is displayed frequently, permanent shutdown will be triggered.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> Contact the SMA Service Line.
dl dl-Srr	<p>The inverter has detected a change in the differential current. A change in the differential current can be caused by an earth fault, residual current or malfunction. The inverter disconnects from the electricity grid.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> If none of the above causes apply and this message is still displayed, ensure that the PV plant is properly insulated and that there is no earth fault present (see Section 10.5.1 "Checking the PV Array for Earth Faults", page 54).

Message	Description and Corrective Measures
EEPROM	<p>Temporary disturbance during reading or writing of data from the EEPROM. This data is not essential for safe operation.</p> <p>This message is for information purposes only and has no effect on the performance of the inverter.</p>
EEPROM dBh	<p>EEPROM data is defective, the device has switched off because the loss of data has disabled important functions of the inverter.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Contact the SMA Service Line.
EeRestore	<p>One of the duplicate records in the EEPROM is defective and has been reconstructed without loss of data.</p> <p>This error message is purely for information purposes and has no effect on the performance of the inverter.</p>
Fac Fac-Bfr FacFast Fac-Srr	<p>The mains frequency is outside the permissible range. The inverter has disconnected from the electricity grid.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Ensure that the AC cable is connected correctly (see Section 6.3.2 "Connecting the Inverter to the Electricity Grid", page 27). • Ensure that the mains frequency is within the permissible range. • If the mains frequency is within the permissible range and this message is still displayed, contact the SMA Service Line.
GOOSE Timeout	<p>No valid Goose commands have been received for one minute. The GOOSE-GoAppld is incorrectly configured or no data can be transmitted.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Check the network cabling and the parameter setting. • Load default values if GOOSE has been activated inadvertently.
Iac-DC_Offs-Srr Iac-DC_Offs-Bfr	<p>Excessive DC current has been detected during feed-in operation.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Ensure that the grid conditions are complied with. • If this message is displayed frequently or recurrently, contact the SMA Service Line.
I_{max}	<p>Overcurrent on the AC side. The current at the AC connection is higher than specified.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Ensure that the PV plant is correctly rated. • Ensure that the grid conditions are complied with.

Message	Description and Corrective Measures
K1-Close	Error during relay test.
K1-Open	Corrective measures:
K2-Open	<ul style="list-style-type: none"> • Contact the SMA Service Line if this disturbance occurs frequently or several times in a row.
MSD-dI	Internal measurement comparison fault or hardware defect.
MSD-Fac	Corrective measures:
MSD-Vac	<ul style="list-style-type: none"> • If this message is displayed frequently, contact the SMA Service Line.
MSD-Timeout	
Offset	<p>Error in measurement data capture</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • If this message is displayed frequently, contact the SMA Service Line.
Riso	<p>The electrical insulation between the PV plant and earth is defective.</p> <p>The resistance between the positive and negative DC connection to earth is outside the permissible range.</p>
	<p>Corrective measures:</p> <ul style="list-style-type: none"> • Ensure that the PV plant is insulated correctly. • Check the PV array for earth faults (see Section 10.5.1).
ROM	The inverter firmware is faulty.
	<p>Corrective measures:</p> <ul style="list-style-type: none"> • If this message is displayed frequently, contact the SMA Service Line.
Shut-Down	Temporary inverter disturbance.
	<p>Corrective measures:</p> <ul style="list-style-type: none"> • Contact the SMA Service Line.
STM Timeout	Internal program run disturbance.
	<p>Corrective measures:</p> <ul style="list-style-type: none"> • If this message is displayed frequently, contact the SMA Service Line.

Message	Description and Corrective Measures
Vac-Bfr Vac-Srr	<p>The mains voltage is no longer within the permissible range. The inverter has disconnected from the electricity grid for safety reasons. This may have the following causes:</p> <ul style="list-style-type: none"> • The miniature circuit-breaker is switched off. • AC cable is interrupted • AC cable is highly resistive. <p>Corrective measures:</p> <ul style="list-style-type: none"> • Ensure that the AC cable is connected correctly (see Section 6.3.2 "Connecting the Inverter to the Electricity Grid", page 27). • Ensure that the mains voltage is within the permissible range. • Ask the network operator for permission to change the parameters Vac-Min / Voltage monitoring upper minimum threshold and Vac-Max / Voltage monitoring lower maximum threshold. • If the AC cable is connected correctly, the mains voltage is within the permissible range and this message is still displayed, contact the SMA Service Line.
VpvMax	<p>Overvoltage at the DC input. The inverter may be destroyed.</p> <p>Corrective measures:</p> <ol style="list-style-type: none"> 1. Disconnect the miniature circuit-breaker. 2. If there is an external DC switch-disconnector, turn it off. 3. If an ESS is in use, disconnect it. 4. Release and disconnect all DC connectors using a screwdriver (blade width 3.5 mm). <ul style="list-style-type: none"> – Insert a screwdriver into one of the side slots. – Pull the DC connectors out. 5. Check whether the DC voltage is below the maximum input voltage of the inverter. If the DC voltage is below the maximum input voltage of the inverter, reconnect the DC connectors to the inverter. If the DC voltage is above the maximum input voltage of the inverter, check the PV plant design or contact the installer of the PV array. 6. If this message recurs frequently, disconnect the inverter from voltage sources (see Section 8) and contact the SMA Service Line.
Vinternal	<p>The internal hardware monitor has detected an overvoltage condition in the intermediate circuit of the inverter.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • If this message is displayed frequently, contact the SMA Service Line.

Message	Description and Corrective Measures
Watchdog	Internal program run disturbance.
Watchdog Srr	Corrective measures: <ul style="list-style-type: none">• If this message is displayed frequently, contact the SMA Service Line.

10.3 Cleaning the Inverter

⚠ CAUTION

Risk of burns from hot heat sink

During operation, the heat sink at the top of the inverter can reach temperatures of over 70 °C.

- Do not touch the heat sink.
- If the heat sink is soiled, clean it with a soft brush or a vacuum cleaner.

NOTICE

Damage to the display due to the use of cleaning agents

- If the inverter is soiled, clean the enclosure lid and the display using pure water and a cloth only.

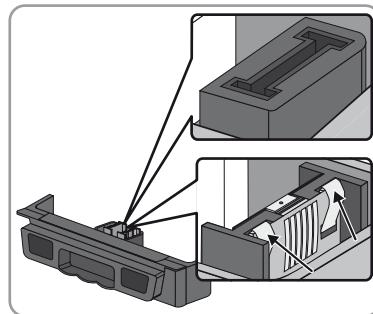
10.4 Checking the ESS for Wear

The ESS is an optional device. Depending on the design of the ESS, you can recognise wear either on the metal tabs or on the plastic casing of the ESS.

1. Remove the ESS.
2. Check the metal tabs or plastic inside the ESS.

There should be no visible discolouration or damage on the metal tabs or the plastic.

If the metal tabs show brown discolouration or are burnt out or the plastic is damaged, the ESS is worn. This means that the ESS can no longer disconnect the PV array reliably. Order a new ESS to replace the damaged one (see Section 13 "Accessories", page 65).



3. **NOTICE**

Risk of fire due to tightening of the ESS screw

Perfect contact between the ESS and the inverter can only be guaranteed if the ESS plug remains flexible.

- Do not tighten the screw in the plug of the ESS.

4. **NOTICE**

Damage to the inverter due to moisture and dust penetration

If the ESS is not plugged in or incorrectly plugged in during operation, moisture and dust can penetrate the inverter. If the ESS is not correctly plugged in, the ESS contacts may be subject to wear, or the ESS may detach from the socket. This can result in yield loss and damage to the ESS.

Always plug the ESS in as follows:

- Firmly plug the ESS in until it is flush with the enclosure.
- Ensure that the gap between the ESS and the enclosure is no more than 1 mm.

5. Commission the inverter (see Section 7.4).

10.5 Red LED Permanently On

If the red LED is permanently on during operation, there is an earth fault present in the PV array or at least one of the varistors for overvoltage protection is defective.

Procedure:

- Check the PV array for earth faults (see Section 10.5.1 "Checking the PV Array for Earth Faults", page 54).
- If the red LED does not go out, check the function of the varistors (see Section 10.5.2 "Checking the Function of the Varistors", page 55).

10.5.1 Checking the PV Array for Earth Faults

If the red LED is on and the inverter displays the message **Riso**, there is an earth fault in the PV array. The electrical insulation between the PV plant and earth is defective or insufficient.

WARNING

Danger to life due to electric shock

In the event of an earth fault, high voltages can be present.

- Only touch the cables of the PV array by their insulation.
- Do not touch any parts of the sub-structure or frame of the PV array.
- Do not connect PV strings with earth faults to the inverter.

Proceed as follows to check each string in the PV plant for earth faults.

1. Disconnect the inverter from all voltage sources (see Section 8).
2. Measure the voltages:
 - Measure the voltages between the positive pole and the earth potential (PE).
 - Measure the voltages between the negative pole and the earth potential (PE).
 - Measure the voltages between the positive and negative poles.

If the following results are returned simultaneously, there is an earth fault in the PV plant.

All measured voltages are stable.

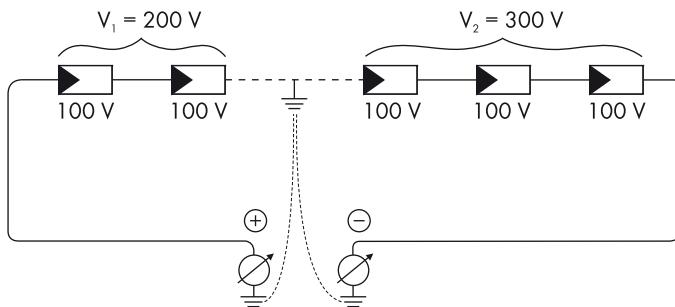
The sum of the two voltages against earth potential is approximately equal to the voltage between the positive and negative poles.

- Determine the location of the earth fault via the ratio of the two measured voltages, and eliminate the earth fault.

If there is no earth fault present and the message is still displayed, contact the SMA Service Line.

Example: Location of the earth fault

The example shows an earth fault between the second and third PV modules.



3. Restart the inverter (see Section 9).

10.5.2 Checking the Function of the Varistors

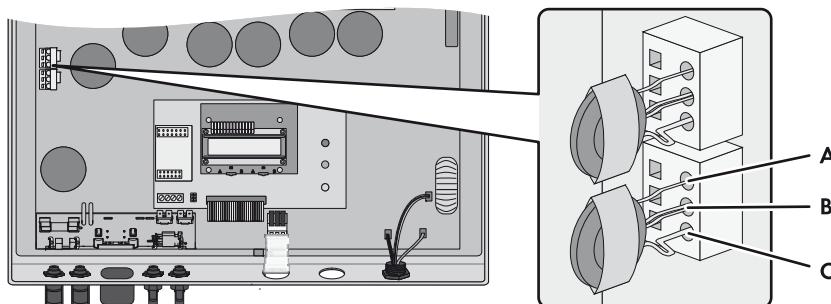


Figure 14: Varistors inside the inverter

Item	Description
A	Upper connection wire
B	Middle connection wire
C	Lower connection wire with loop

NOTICE**Destruction of the inverter due to overvoltage**

If varistors are missing, the inverter is no longer protected against overvoltage.

- Do not operate the inverter without varistors in plants with a high risk of overvoltages.
- Do not recommission the inverter until the defective varistors have been replaced.

Procedure:

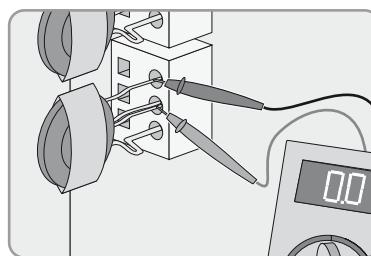
Check the function of each varistor according to the following procedure.

1. Disconnect the inverter from all voltage sources (see Section 8).
2. Remove all screws from the enclosure lid and pull the enclosure lid evenly forward and off.
3. Remove the protective conductor (PE) connection from the bottom of the enclosure lid.
4. Use a measuring device to measure whether there is a conductive connection between the upper and the middle connection wire.

If there is no conductive connection, the varistor is defective. SMA Solar Technology AG recommends replacing all varistors immediately.

- Order new varistors and insertion tools (see Section 13 "Accessories", page 65).
- If new varistors are available, replace all varistors (see Section 10.5.3).

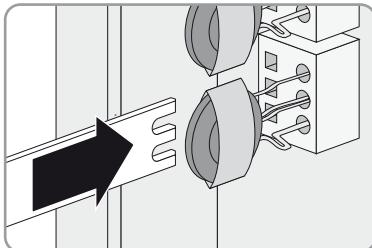
If a conductive connection is present, contact the SMA Service Line.



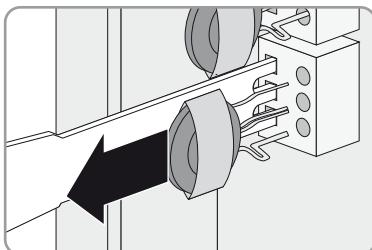
10.5.3 Replacing the Varistors

Proceed as follows to replace each varistor.

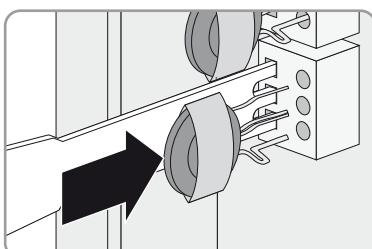
1. Disconnect the inverter from all voltage sources (see Section 8).
2. Remove all screws from the enclosure lid and pull the enclosure lid evenly forward and off.
3. Remove the protective conductor (PE) connection from the bottom of the enclosure lid.
4. Insert the insertion tool into the contacts of the terminal block.



5. Remove the varistor from the terminal block.



6. Insert the new varistor into the terminal block. Remember to insert the connection wire with the loop into the lower terminal.



7. Remove the insertion tool from the contacts of the terminal block.
8. Restart the inverter (see Section 9).

11 Decommissioning the Inverter

⚠ CAUTION

Risk of injury when lifting the inverter, or if it is dropped

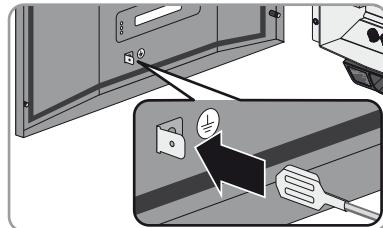
The inverter is heavy (see Section 12 "Technical Data", page 60). There is risk of injury if the inverter is lifted incorrectly or dropped during transport or while being fixed to the wall mounting bracket.

- Keep the inverter horizontal during transport.

1. ⚠ DANGER

Danger to life due to high voltages

- Disconnect the inverter from all voltage sources (see Section 8).
- 2. Remove all screws from the enclosure lid and pull the enclosure lid evenly forward and off. Release the fastening of the PE connection on the lid.
- 3. If a data cable is connected, pull it out of the inverter.
- 4. Make the protective conductor (PE) connection from the inverter to the bottom of the enclosure lid.

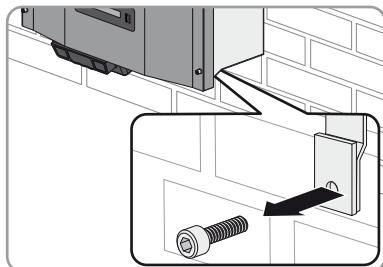


- 5. Fasten the enclosure lid to the inverter by evenly tightening the 4 lid screws (torque: 2 Nm).

6. ⚠ CAUTION

Risk of burns due to hot enclosure parts

- Wait 30 minutes for the enclosure to cool down.
- 7. If the inverter is screwed to the wall mounting bracket, release the screw between the inverter and the bracket.



8. If a second protective conductor is connected, release the M6x16 cheese-head screw and remove the protective conductor.

9.  **CAUTION**

Risk of injury when lifting the inverter, or if it is dropped

The inverter is heavy (see Section 12 "Technical Data", page 60). There is risk of injury if the inverter is lifted incorrectly or dropped during transport.

- Keep the inverter horizontal when lifting it off the wall mounting bracket and transporting it.

10.

NOTICE

Damage to the ESS socket from dirt and foreign bodies

If the inverter is placed on an uneven surface, dirt or foreign bodies, e.g. grit, may penetrate the socket and damage the contacts. This will impair the function of the ESS.

- Always set the inverter down on an even surface.

11. If the inverter is to be stored or shipped in a package, pack the inverter and, if applicable, the ESS. Use the original packaging or packaging that is suitable for the weight and dimensions of the inverter.
12. If the inverter is to be disposed of, do this in accordance with the locally applicable disposal regulations for electronic waste.

12 Technical Data

DC Input

	SB 1300TL-10	SB 1600TL-10	SB 2100TL
Maximum DC power at $\cos \varphi = 1$	1,400 W	1,700 W	2,200 W
Maximum input voltage	600 V	600 V	600 V
MPP voltage range	115 V to 480 V	155 V to 480 V	200 V to 480 V
Rated input voltage	400 V	400 V	400 V
Minimum input voltage	100 V	125 V	125 V
Initial input voltage	120 V	150 V	150 V
Maximum input current	12 A	12 A	12 A
Maximum input current per string	12 A	12 A	12 A
Maximum short-circuit current	12 A	12 A	12 A
Number of independent MPP inputs	1	1	1

AC Output

	SB 1300TL-10	SB 1600TL-10	SB 2100TL
Rated power at 230 V, 50 Hz	1,300 W	1,600 W	1,950 W
Maximum apparent AC power $\cos \varphi = 1$	1,300 VA	1,600 VA	2,100 VA
Rated mains voltage	230 V	230 V	230 V
AC nominal voltage	220 V / 230 V / 240 V	220 V / 230 V / 240 V	220 V / 230 V / 240 V
AC voltage range	180 V to 260 V	180 V to 260 V	180 V to 260 V
Nominal AC current at 220 V	5.9 A	7.3 A	8.7 A
Nominal AC current at 230 V	5.7 A	7.0 A	8.5 A
Nominal AC current at 240 V	5.4 A	6.7 A	8.1 A
Maximum output current in the event of an error	14 A	14 A	14 A
Total harmonic factor of output current at AC voltage > 2% and AC power > 0.5 of rated power	≤ 3%	≤ 3%	≤ 3%
Rated mains frequency	50 Hz	50 Hz	50 Hz
AC mains frequency	50 Hz / 60 Hz	50 Hz / 60 Hz	50 Hz / 60 Hz

	SB 1300TL-10	SB 1600TL-10	SB 2100TL
Operating range at AC mains frequency 50 Hz	44 Hz to 55 Hz	44 Hz to 55 Hz	44 Hz to 55 Hz
Operating range at AC mains frequency 60 Hz	54 Hz to 65 Hz	54 Hz to 65 Hz	54 Hz to 65 Hz
Power factor at rated power	1	1	1
Feed-in phases	1	1	1
Connection phases	1	1	1
Overvoltage category according to IEC 60664-1	III	III	III

Efficiency

	SB 1300TL-10	SB 1600TL-10	SB 2100TL
Maximum efficiency, η_{\max}	96.0%	96.0%	96.0%
European weighted efficiency, η_{EU}	94.3%	95.0%	95.2%

General Data

Width x height x depth	440 mm x 299 mm x 214 mm
Width x height x depth, with ESS	440 mm x 339 mm x 214 mm
Weight	16 kg
Length x width x height of packaging	532 mm x 392 mm x 318 mm
Weight with packaging	21.2 kg
Climatic category according to IEC 60721-3-4	4K4H
Environment category	outdoors
Degree of pollution outside the enclosure	3
Degree of pollution inside the enclosure	2
Operating temperature range	– 25 °C to +60 °C
Maximum permissible value for relative humidity, non-condensing	100%
Maximum operating altitude above MSL	2,000 m
Noise emission (typical)	≤ 33 dB(A)
Power loss in night mode	0.1 W
Topology	transformerless
Cooling concept	convection

Degree of protection according to IEC 60529	IP65
Protection class according to IEC 62103	I
Grid configurations	TN-C system, TN-S system, TN-C-S system, TT system, when $V_{N_PE} > 30$ V, IT system, Delta-IT system, Split Phase
Licences (as per 04/2013)	CE, VDE0126-1-1, G83/1-1, RD 661/2007, PPC, AS 4777, EN 50438, C10/11, PPDS, UTE C15-712-1, VDE-AR-N 4105, CEI 0-21, RD1699*, NRS 097-2-1**, DIN EN 62109-1, IEC 62109-2***

* To find out about restrictions in certain regions, contact the SMA Service Line.

** This standard stipulates that a special label be attached to the AC distribution to draw attention to the AC-side disconnection of the inverter in the event of grid failure (for more details, see NRS 97-1-2, Sec. 4.2.7.1 and 4.2.7.2)

*** In order to meet the requirements of this standard, use of the fault indication relay must be activated in the inverter or there must be a link to Sunny Portal with the fault alert via e-mail activated.

Protective Devices

DC reverse-polarity protection	short-circuit diode
Input-side disconnection device*	Electronic Solar Switch
DC overvoltage protection	thermally monitored varistors
AC short-circuit protection	current control
Grid monitoring	SMA Grid Guard 2.1
Maximum permissible fuse protection	16 A
Earth fault monitoring	Insulation monitoring: $R_{iso} > 1 \text{ M}\Omega$
All-pole sensitive residual-current monitoring unit	installed

* optional

Climatic Conditions in Accordance with IEC 60721-3-4, Installation Type C, Class 4K4H

Extended temperature range	– 25 °C to +60 °C
Extended humidity range	0% to 100%
Extended air pressure range	79.5 kPa to 106 kPa

Climatic Conditions in Accordance with IEC 60721-3-4, Transport Type E, Class 2K3

Temperature range	– 25 °C to +70 °C
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Features

DC connection	SUNCLIX DC connector
AC Connection	AC connector
Display	LC text display
Bluetooth® Wireless Technology	optional
RS485, galvanically isolated	optional
Speedwire with Webconnect function	optional

Fault Indicator Relay

Maximum AC switching voltage	240 V
Maximum DC switching voltage	30 V
Maximum AC switching current	1.0 A
Maximum DC switching current	1.0 A
Minimum electrical endurance when the maximum switching voltage and maximum switching current are complied with*	1,000,000 switching cycles

* Corresponds to 20 years at 12 switching operations per day

Electronic Solar Switch*

Electrical endurance in the event of a short circuit, at nominal current of 35 A	at least 50 switching operations
Maximum switching current	35 A
Maximum switching voltage	800 V
Maximum PV power	11 kW
Degree of protection when plugged in	IP65
Degree of protection when unplugged	IP21
Fuse for Electronic Solar Switch	F200, 600 V/4 A, fast (soldered, not replaceable)

* optional

Torques

Enclosure lid screws	2.0 Nm
Screw for additional earthing	6.0 Nm
Cheese-head screw for attaching the enclosure to the wall mounting bracket	6.0 Nm
SUNCLIX swivel nut	2.0 Nm
RS485 communication connection	1.5 Nm

13 Accessories

You will find the appropriate accessories and spare parts for your product in the following overview. If required, you can order these from SMA Solar Technology AG or your specialist dealer.

Designation	Brief description	SMA order number
Electronic Solar Switch	ESS as spare part	ESS-HANDLE*
Replacement varistors	Set of thermally monitored varistors (2 pcs.) incl. insertion tool SB TVWZ	SB-TV4
RS485 retrofit kit	RS485 interface	485PB-NR
Bluetooth retrofit kit	Bluetooth interface	BTPBINV-NR
Speedwire/Webconnect retrofit kit	Speedwire/Webconnect Piggy-Back for Speedwire networks and data exchange with Sunny Portal	SWPB-10
SUNCLIX DC connector	Field plug for conductor cross-sections 2.5 mm ² to 6 mm ²	SUNCLIX-FC6-SET

* When ordering a new ESS, always supply the device type and serial number of the inverter.

14 Contact

If you have technical problems concerning our products, please contact the SMA Service Line. We require the following information in order to provide you with the necessary assistance:

- Inverter type
- Inverter serial number
- Type and number of PV modules connected
- Optional equipment, e.g. communication devices
- Inverter blink code or display message

Australia	SMA Australia Pty Ltd. Sydney	Toll free for Australia: (1800 762 287) International: +61 2 9491 4200
Belgien/ Belgique/ België	SMA Benelux bvba/sprl Mechelen	+32 15 28 67 30
Česko	SMA Central & Eastern Europe s.r.o. Praha	+420 235 010 417
Danmark	Se Deutschland (Tyskland)	
Deutschland	SMA Solar Technology AG Niestetal	<p>Medium Power Solutions</p> <p>Wechselrichter: +49 561 9522-1499 Kommunikation: +49 561 9522-2499 SMS mit „Rückruf“: +49 176 888 222 44</p> <p>Hybrid Energy Solutions</p> <p>Sunny Island: +49 561 9522-399</p> <p>Power Plant Solutions</p> <p>Sunny Central: +49 561 9522-299</p>
España	SMA Ibérica Tecnología Solar, S.L.U. Barcelona	+34 900 14 22 22
France	SMA France S.A.S. Lyon	<p>Medium Power Solutions</p> <p>Onduleurs : +33 (0)4 72 09 04 40 Communication : +33 (0)4 72 09 04 41</p> <p>Hybrid Energy Solutions</p> <p>Sunny Island : +33 (0)4 72 09 04 42</p> <p>Power Plant Solutions</p> <p>Sunny Central : +33 (0)4 72 09 04 43</p>

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